Creation of high-resolution archive for Russian Arctic using COSMO-CLM 5.0 model

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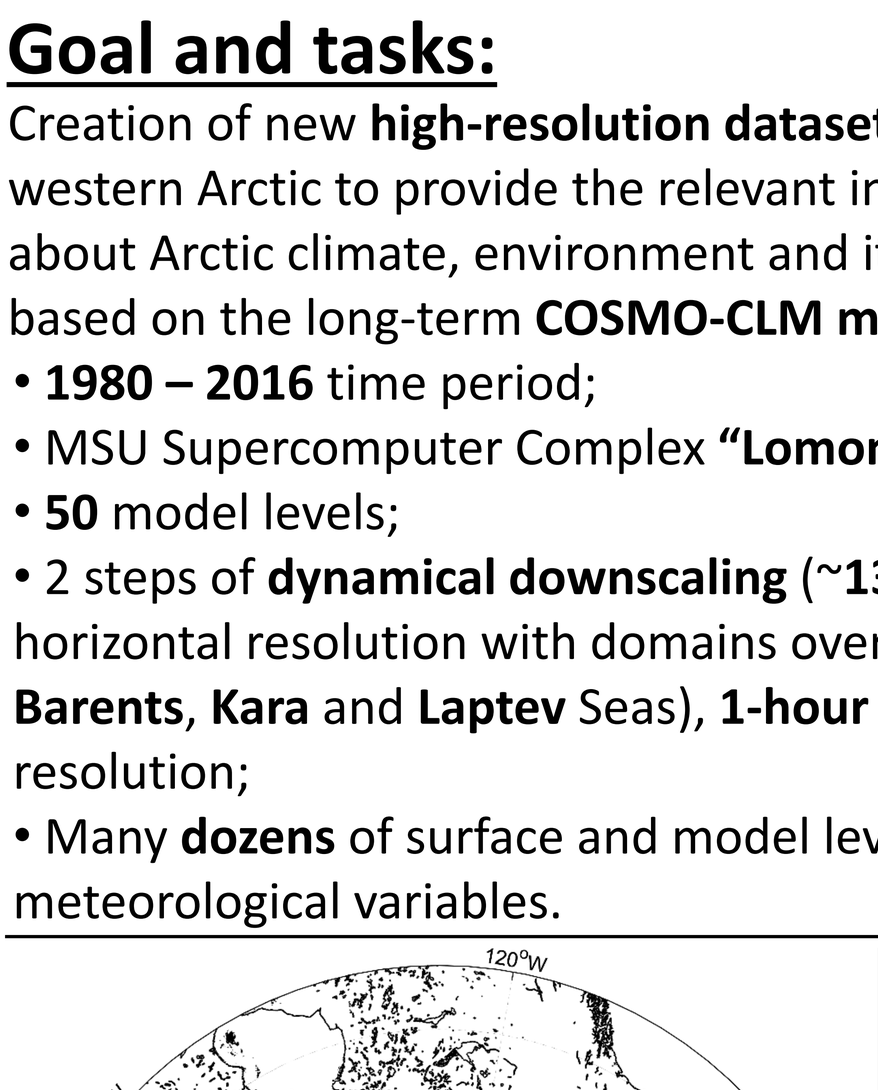
Goal and tasks:

Creation of new **high-resolution dataset** over the western Arctic to provide the relevant information about Arctic climate, environment and its changes based on the long-term **COSMO-CLM model** runs.

- **1980 – 2016** time period;
- MSU Supercomputer Complex **"Lomonosov-2"**;
- **50** model levels;
- 2 steps of **dynamical downscaling** (~**13** and ~**3 km** horizontal resolution with domains over the **Barents**, **Kara** and **Laptev** Seas), **1-hour** temporal resolution;
- Many **dozens** of surface and model levels meteorological variables.



Current status: base domain is now simulating, 1980 – 1991, 2010 – 2016 are yet calculated

Conclusion

- **synoptic-scale variability** is *reproducing very well*;
- **'spectral nudging'** technique *reduces biases*, main advances are for **coastal** wind speeds and **inland** temperatures;
- **Turbulence scheme** tuning *improves winter temperature biases* for **inland** stations;
- **New model version 5.05** is similar to the turbulence scheme tunung, and *improves summertime experiment*;
- *No significant differences* between **ERA-Interim** and **ERA5 forcings**; no clear effects of different **'cold start'** times revealed.

CONSORTIUM FOR SMALL SCALE MODELING COSMO

Test experiments:

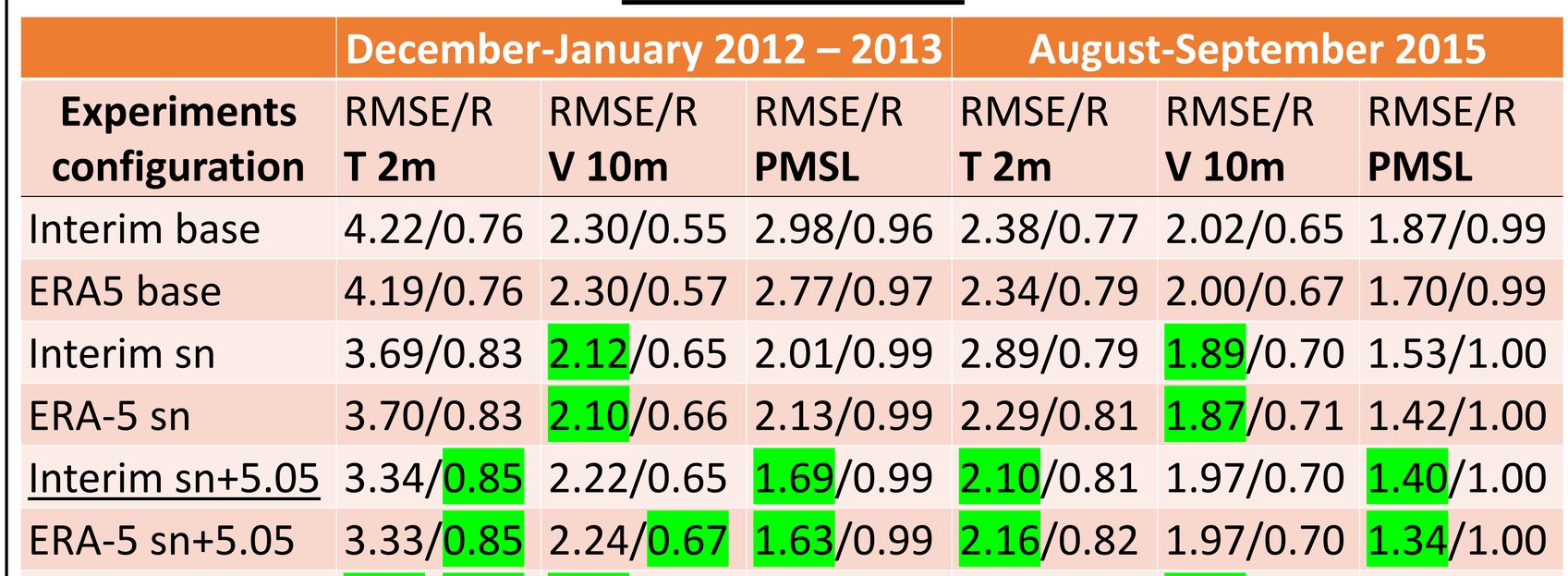
Periods: ***August-September 2015, December-January 2012-2013***

- **Different forcing** (ERA-Interim, ERA5);
- **Model versions** (v. 5.0 vs. v.5.05);
- Switch on/off **'spectral nudging'** parameters;
- **'Cold start'** time (no *'cold start'* or *1 month*);
- **Turbulence scheme** standard or with **tuning** (*tkhmin=tkmmin=0.1; pat_len = 100*).

Verification

	December-January 2012 – 2013			August-September 2015		
Experiments configuration	RMSE/R **T 2m**	RMSE/R **V 10m**	RMSE/R **PMSL**	RMSE/R **T 2m**	RMSE/R **V 10m**	RMSE/R **PMSL**
Interim base	4.22/0.76	2.30/0.55	2.98/0.96	2.38/0.77	2.02/0.65	1.87/0.99
ERA5 base	4.19/0.76	2.30/0.57	2.77/0.97	2.34/0.79	2.00/0.67	1.70/0.99
Interim sn	3.69/0.83	2.12/0.65	2.01/0.99	2.89/0.79	1.89/0.70	1.53/1.00
ERA-5 sn	3.70/0.83	2.10/0.66	2.13/0.99	2.29/0.81	1.87/0.71	1.42/1.00
Interim sn+5.05	3.34/0.85	2.22/0.65	1.69/0.99	2.10/0.81	1.97/0.70	1.40/1.00
ERA-5 sn+5.05	3.33/0.85	2.24/0.67	1.63/0.99	2.16/0.82	1.97/0.70	1.34/1.00
Interim turb+sn	3.38/0.84	2.12/0.65	2.08/0.99	2.35/0.79	1.89/0.69	1.57/1.00
ERA-5 turb+sn	3.37/0.85	2.09/0.66	2.18/0.99	2.35/0.81	1.88/0.70	1.45/1.00

Temperature 2 m, winter 2012-2013



Model is ***reinitializing monthly*** to control the *«long-term memory»* of climate system. Substitution of ***U, V, T, QV, QC, QI, QG, QR, QS, T_S, T_SO[1,2], T_ICE, H_ICE, C_T_LK, DEPTH_LK, H_B1_LK, H_ML_LK, T_B1_LK, T_BOT_LK, T_MNW_LK, T_WML_LK, PP*** variables in reanalysis **laf-file**.

laf${YEAR}${MONTH}0100.nc

→ ***lffd${YEAR}${MONTH+1}0100.nc***

laf${YEAR}${MONTH+1}0100.nc

Substitution of atmospheric variables from ***lffd…nc*** file into ***laf…nc*** file.

→ ***lffd${YEAR}${MONTH+2}0100.nc***

Etc. …

laf${YEAR}${MONTH+2}0100.nc

Reference. ***Vladimir Platonov*** and ***Mikhail Varentsov***. Creation of the long-term high-resolution hydrometeorological archive for Russian Arctic: methodology and first results. *IOP Conference Series: Earth and Environmental Science*, 386(012), 2019. https://doi.org/10.1088/1755-1315/386/1/012039

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